



Chemical and biological impacts of ocean acidification along the west coast of North America



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ABSTRACT

The continental shelf region off the west coast of North America is seasonally exposed to water with a low aragonite saturation state by coastal upwelling of CO₂-rich waters. To date, the spatial and temporal distribution of anthropogenic CO₂ (C_{anth}) within the CO₂-rich waters is largely unknown. Here we adapt the multiple linear regression approach to utilize the GO-SHIP Repeat Hydrography data from the northeast Pacific to establish an annually updated relationship between C_{anth} and potential density. This relationship was then used with the NOAA Ocean Acidification Program West Coast Ocean Acidification (WCOA) cruise data sets from 2007, 2011, 2012, and 2013 to determine the spatial variations of C_{anth} in the upwelled water. Our results show large spatial differences in C_{anth} in surface waters along the coast, with the lowest values (37–55 μmol kg⁻¹) in strong upwelling regions off southern Oregon and northern California and higher values (51–63 μmol kg⁻¹) to the north and south of this region. Coastal dissolved inorganic carbon concentrations are also elevated due to a natural remineralized component (C_{bio}), which represents carbon accumulated through net respiration in the seawater that has not yet degassed to the atmosphere. Average surface C_{anth} is almost twice the surface remineralized component. In contrast, C_{anth} is only about one third and one fifth of the remineralized component at 50 m and 100 m depth, respectively. Uptake of C_{anth} has caused the aragonite saturation horizon to shoal by approximately 30–50 m since the preindustrial period so that undersaturated waters are well within the regions of the continental shelf that affect the shell dissolution of living pteropods. Our data show that the most severe biological impacts occur in the nearshore waters, where corrosive waters are closest to the surface. Since the pre-industrial times, pteropod shell dissolution has, on average, increased approximately 19–26% in both nearshore and offshore waters.

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1. Introduction

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